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Comparing aversive and appetitive learning performances in individual honeybees

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Animals learn to associate initially neutral sensory stimuli (color, odor, etc.) with positive (food) or negative events (danger), based on appetitive and aversive learning respectively. The honeybee (*Apis mellifera*) is an influential invertebrate model for studying both types of olfactory learning. Appetitive learning is studied using the protocol for conditioning the proboscis extension response (PER), in which bees learn to associate an odor (conditioned stimulus, CS) with a sucrose reward (unconditioned stimulus, US). Aversive learning is studied using the sting extension response (SER) conditioning, in which an odor CS is associated with an aversive US, in our case a thermal stimulation to the mouthparts. We investigated the relationships between appetitive and aversive learning capacity at the individual level, and the potential influence of bee genotype on both learning types. As learning performance was shown to depend on individuals sensitivity to the US, we measured four different traits systematically in each individual bee: sensitivity to sucrose, PER learning with sucrose US, sensitivity to temperature, SER learning with temperature US. First, we confirmed for both types of learning that learning performance correlates with US responsiveness. Second, we found a trend for a possible trade-off between appetitive and aversive learning performances: bees that were better appetitive learners (and had a lower sucrose US threshold) tended to learn less efficiently (and to show a higher temperature US threshold). This result suggests a potential differential specialization of workers within the hive. We then investigated the influence of genotype on bee's performances. A queen bee usually mates with 15-20 drones, so that within the hive, her worker offspring belong to as many different patrilines. Using microsatellite analysis, we identified the patriline origin of all tested workers. Analyses are still under way but should tell whether aversive and appetitive learning performances are under a genetic influence.